FRACTURE THROUGH THE ANATOMICAL NECK OF THE HUMERUS WITH DISLOCATION OF THE HEAD.

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FRACTURES through the anatomical neck of the humerus, associated with dislocation of the head, present features so distinctive in the mechanism of their production, in their pathology, in their amenability to external treatment, and in the nature of their operative treatment, as to place them in a class by themselves.

Fifty years before the Christian era, Pasticrates treated of fracture-dislocation at the shoulder-joint; but no case of fracture of the anatomical neck with dislocation is recorded prior to 1823, when Delpech reported the case observed by Houzelot in 1808. It has thus been exactly a century since this injury has been recognized as a distinct entity; and even to the present time, it has been treated in literature only in connection with other fracture-dislocations at the shoulder. This is not to be wondered at, when it is considered that, so far, only 34 undoubted cases have been recorded. If to these are added 9 unverified cases, the number still is small for a definite lesion whose history extends over a hundred years.

The present paper is concerned with the report of a typical case, under the author's care, with a résumé of the other cases on record, and a consideration of the mechanism of the injury and the methods of treatment.

AUTHOR'S CASE.—On June 14, 1907, Mrs. O., 58 years of age, tripped on a plank, while walking on sloping ground, and pitched forward, falling full length. She is unable to say just how her arm and shoulder met the ground, but she was certain at the time, that very great violence had been sustained. Her physician, Dr. Hamilton, was summoned and made a diagnosis of dislocation of the shoulder. He at once placed her under the influence of chloroform and made efforts at reduction. After several trials these efforts appeared to be successful and the arm was bandaged to the chest wall. Pain of the most persistent and severe character, extending down the arm, continued for the next sixteen days, at the expiration of which time the author saw the patient in consultation.

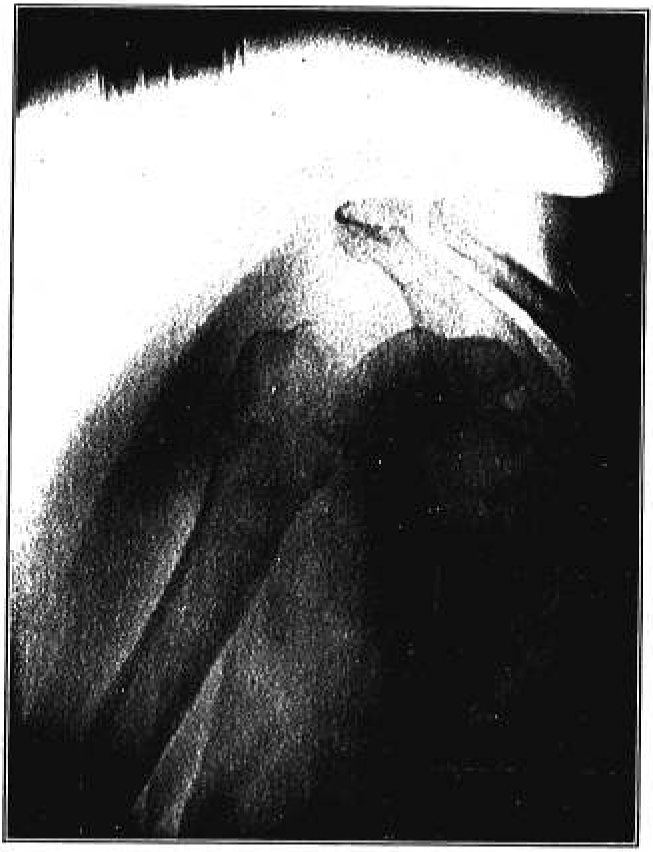
The ordinary signs of dislocation were not present. The rotundity of the shoulder was almost completely preserved. The elbow could be applied to the chest wall and the hand placed on the opposite shoulder. The tuberosities could be felt to rotate under the acromion when the shaft of the humerus was turned on its axis. No crepitus could be elicited. Although the usual signs of dislocation and fracture were absent, the persistent pain and helplessness of the limb indicated a serious injury and rendered an X-ray examination advisable.

The next day the plate represented by Fig. 1 was made by Dr. R. H. Boggs of this city, and it became at once evident that there existed a fracture of the anatomical neck with subglenoid or axillary dislocation of the head.

Operation.—On July 4th (20 days after injury), at Columbia Hospital, the patient was anæsthetized and an incision made along the lower border of the anterior axillary fold. This was deepened till the axillary vessels and nerves were reached. These were found to stretch tightly over the underlying dislocated head, which was firmly embedded in the soft tissues. To a portion of the circumference of the neck was still attached the capsular ligament, and so firmly was the head held under the vessels that efforts to displace it were without avail and it seemed that it would be impossible to dislodge it, without injury to the overlying vessels. By cutting the shreds of capsule from its periphery and by patient manipulation of the vessels, and strong traction with lion-jawed forceps, the head (Fig. 2) was finally extracted. The wound healed without reaction and the patient returned to her home in two weeks.

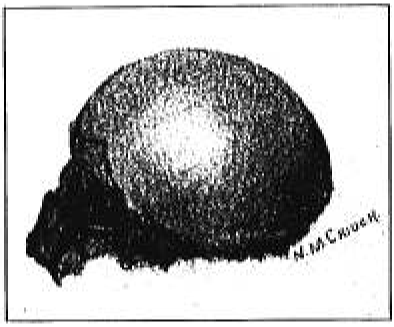
She was examined on December 31st (about six months after injury) and the following condition found: Arm of normal appearance. Very little wasting. Arm hangs naturally to side. Unaided abduction of arm possible only to extent of about 45 degrees. By passive movements, the arm can easily be brought

FIG. 1.



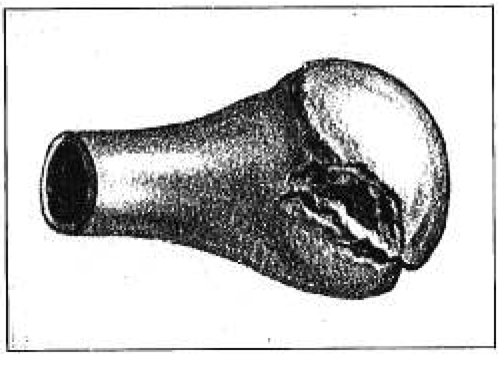
Fracture of anatomical neck of the humerus, with subglenoid dislocation of the head.

FIG. 2.



Fractured and dislocated head of humerus after removal by operation.

FIG. 3.



Dislocation of humerus with indentation of the anatomical neck. (Caird.)

almost to horizontal. All the movements of forearm, normal and swinging movements of limb satisfactory. Use of arm much improved in last three months. Patient has much neuralgic pain extending along the course of the median nerve. This is no doubt due to a neuritis from pressure of the head prior to removal.

CASES RECORDED IN THE LITERATURE.*

The cases of this injury, so far reported, may be separated into three groups: (1) Clinical cases verified by operation or autopsy; (2) Clinical cases not so verified, but depending for their diagnosis on the opinion of the attending surgeons; (3) Specimens without clinical history.

I. Clinical Cases Verified By Operation or Autopsy.

(29 in all)

A.—Cases not Subjected to Operation.

(12 in number)

1. Houzelot (1808) (reported by Delpech).—Injury was the result of a fall from a stroke of apoplexy. Posterior dislocation of head.

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* The following cognate injuries are not included in the present account; but the histories of all such cases have been examined to assure the completeness of the regular list.

1. Pertubercular fractures with dislocation.

2. Fractures of "the neck" with dislocation, in which no definite statement is made by the reporter, as to line of fracture.

3. Fracture of surgical neck with dislocation.

4. Incomplete or impacted fractures of anatomical neck with dislocation (4 cases—Anger, Bennett, Maxwell, Heilberg).

5. Fractures of neck produced by futile efforts at reduction of dislocation.

6. Cases in which union had occurred in a fracture-dislocation of the anatomical neck and subsequent operation was done (two cases):

Tansini (La Riforma Med., Napoli, 1897, xiii, Pt. 2, 173) in a man of 44 years, resected 8 cm. of the upper end of the luxated humerus, which showed an united fracture of the anatomical neck.

Royster (Journal Amer. Med. Assoc., 1907, xlix, 487) in a boy of 20 years, replaced by open incision a subcoracoid luxation of a humerus, in which "close inspection revealed a line of callus formation, and deformity, indicating a healed fracture through the anatomical neck of the humerus." The outcome of the case was most gratifying.

Perhaps the six cases in groups 4 and 6 belong more properly in the regular list; but a careful study of the original reports has induced the author to place them in classes by themselves.

Patient died in twelve days. Autopsy. *Thamhayn: Inaug. Dissert. Ueber die mit Fractur des Collum Humer. complicirten Schulter Luxationen, No.* 26.

2. TRAVERS (1823).—Fall. Head dislocated into axilla. Both tuberosities separated from shaft and drawn in opposite directions. Death months later. Autopsy. *London Med. Repository,* 1823, xx, 222. *Gurlt. Handbuch der Lehre, von den Knochenbruchen, Obs.* 97, p. 696.

3. LALLEMAND (1827).—Fall of 12 or 15 feet. Head dislocated under clavicle. Additional fracture of greater tuberosity. Efforts at reduction futile. Death from Erysipelas in 38 days. Autopsy. *Oger. (A) Etude sur Les luxations scapulo-humerales compliquees de fracture de la partie superieure de l'humerus. Paris,* 1884. No. 52.

4. HEALE (1835).—Man of 60 years. Efforts to reduce on the second day failed. Death 15 months later. Autopsy. *Thamhayn, loc. cit.* No. 25.

5. COOPER (1824).—Fall from a horse. Failure of efforts to reduce. Autopsy many years later. *Guy's Hosp. Rep.* 1839, iv, 273.

6. KEY (1839).—Man of 63. Tripped at head of stairs and fell with outstretched arm and rolled to bottom, striking his shoulder violently on the way. Death in three months. Autopsy showed fracture of anatomical neck, also united fractures of six pieces "close to the neck," with subglenoid luxation of the head. *Guy's Hosp. Rep.* 1840, v. 92.

7. MALGAIGNE (1840).—Patient seen about six weeks after injury. Cause of injury unknown. Died with suppuration two months after injury. Autopsy showed fracture of both anatomical and surgical neck with dislocation of head. *Malgaigne: Traite des fractures et des luxations,* Paris, 1855, p. 547.

8. MANZINI (1840).—Man of 57 years. Fracture of both anatomical neck and surgical neck and forward dislocation of head. Efforts at reduction unsuccessful. Death two months later; suppuration. Autopsy. *Thamhayn, loc. cit.* No. 31.

9. LENOIR (1851).—Fat woman of 83 years. Fell from heat of sun with oustretched arm. Fracture of both anatomical and surgical neck. No effort made to reduce head of bone. Died of apoplexy, after consolidation. *Oger, loc. cit.* No. 53.

10. SURGEON TO MANCHESTER ROYAL INFIRMARY (1852).—Man of 58 years. Fell from a height and "pitched on his shoulder." Fracture of anatomical neck and one just below the surgical neck, with luxation of the head into the pectoral muscle. Death on the sixth day from gastric hemorrhage from ulcer. Autopsy. *Provincial Med. and Surg. Jour.,* 1852, 267.

11. ST. THOMAS' HOSPITAL MUSEUM (reported 1861).—History of a fall from a horse many years before. *Trans. Path. Soc. London,* 1861, xii, 188. *Gurlt. loc. cit.* Obs. 116, p. 705.

12. MABBOUX (1877).—Adult male. Fall from horse. Luxation of head into axilla. Death in thirty days. Autopsy. *Poirier et Mauclaire: Revue de Chirurgie, Oct.* 1892. iv, p. 849.

B.—Cases in Which the Head Was Excised.

(14 in number)

1. Morton (1884).—Man of 73. Fall down stairs. Head freely movable in axilla. Vigorous efforts at reduction unsuccessful. Head excised. Patient ready for dismissal in 13 days, when he had an attack of diarrhœa from which he died one week later. *Am. J. Med. Sci.*, 1884, lxxxvii, 173.

2. Poirier (1889).—Man of 37. Fall with hand carried forward. Shoulder did not touch the ground. Head luxated into the axilla. Efforts at reduction without avail. Head removed by incision. Very good use of the arm resulted. Arm could be brought to horizontal; other movements satisfactory. *Poirier et Mauclaire, loc. cit., Obs.* v, p. 849.

3. Croft (1889).—Patient 33 years old. Fall through a trap-door eighteen feet. Subglenoid dislocation of head. Ineffectual efforts to reduce under chloroform. Head removed by incision three days after injury. Moderately good result. *Lancet*, 1890, i, 701.

4. Clutton (1892).—Woman 61 years old. Luxation of head into axilla. Head removed eight days after injury by incision. Head lifted out without the use of a knife or scissors. Excellent result. *Souchon. Transact. Amer. Surg. Assoc.*, 1897, xv, 330.

5. Poirier et Mauclaire (1892).—Man of 63. Fell on his shoulder on the partition of a coal-bin. Efforts at reduction failed. Incision and removal of head twenty-four days later. *Poirier et Mauclaire, loc. cit. Obs. vi.*

6. McGraw (1896).—Man of 45. Head luxated into axilla. Operation four weeks later. Three inch incision made through deltoid, through which it was impossible to reach the head. Axillary incision then made, and removal of head with difficulty, it being firmly held between capsule and bone. Excellent result. *Souchon, loc. cit.* 331.

7. Gerster (1897).—Man of 47. Fall from car on outstretched arm. Open incision and removal of head one month after injury. Vessels and nerves stretched over head. Death from infection. Annals of Surgery, 1897, xxvii, 660.

8. Salmon (1899).—Fall down stairs. Head luxated into axilla. Head excised 11 weeks after injury. *Medical Council, Phila.*, 1900, v, 134.

9. Curtis (1899).—Man of 29. Fell in a "fit" and struck his shoulder. Subcoracoid luxation. Operation 21 days after injury. Incision along margin of deltoid. Head easily removed. Good result. Annals of Surgery, 1900, xxxi, 295.

10. Brigham (1899).—Man of 34. Thrown from a buggy in a runaway, falling on the palm of his hand. Five months later, head was removed through incision along border of pectoralis major. Head had united to shaft. Good result. Annals of Surgery, 1900, xxxi, 614.

11. Jepson (1899).—Man of 48. Knocked down by a carriage. Intracoracoid luxation of head. Removal of head. Good result. *Western Med. Rev.*, 1900, v, 297.

12. **Dollinger** (1902).—Excision of head probably done. Particulars scanty. *Centralbl. f. Chir.* 1902, xxix, 1277.

13. **Keen** (1905).—Man of 60. Fall on the shoulder. Subcoracoid luxation with reversal of head. Head removed 5½ weeks later. Very adherent. Care necessary to avoid injury to vessels and nerves. Good result. ANNALS OF SURGERY, 1907, xlv, 945.

14. **Buchanan** (1907).—Case above reported.

C.—Cases in Which the Head was Returned to the Glenoid Cavity.

(3 in number)

1. **Wölfler** (1890).—Male adult. Recent dislocation. Head free in the axilla. Axillary incision. Reduction of head and pegging of fragments. Primary union. Remote result, fair. *Souchon, loc. cit.* p. 328.

2. **McBurney** (1895).—Man of 28. Fell from a chair in a "fit." Subcoracoid luxation. Operation by deltoid incision, 25 days later. Head replaced in glenoid cavity with McBurney's hook and vigorous external finger pressure. Good use of arm resulted. ANNALS OF SURGERY, 1896, xxiii, 501.

3. **Curtis** (1899).—Girl of 11. Fall on shoulder and head. Head luxated into axilla. Operation the day after injury after futile attempts at reduction. Anterior incision at border of deltoid failed to expose the head. Kocher's posterior incision, with temporary resection of acromion was then made. By strong pressure of the fingers, through both wounds and in the axilla, the head was, with difficulty, forced into the glenoid cavity. A tendency of the shaft to ride upward was counteracted by the passage of a drill into the head, grazing the upper end of the lower fragment. Primary union. Good result. Abduction to 60° at time of report. ANNALS OF SURGERY, 1900, xxxi, 301.

II.—CLINICAL CASES NOT VERIFIED BY X-RAY, OPERATION OR AUTOPSY.

(9 in all)

1. **v. Langenbeck** (1855).—Man of 22. Kicked by a horse. Subcoracoid luxation of the head. Efforts at reduction unsuccessful on two occasions. Good final result. Arm could be brought to horizontal. *Gurlt. loc. cit.* Obs., 175, p. 736.

2. **Dunn, Smith & Erichsen** (1862).—Young man. Epileptic. Had a convulsion, and was saved from falling by his brother. It was the opinion that "the anatomical neck was broken across." Mr. Smith "forcibly seized the end of the depressed bone with both his hands, and lifting it up in the direction of the socket, found to his great satisfaction and surprise that the head of the bone slipped readily into the glenoid cavity." The result was a perfect cure. The context, however, would lead to the belief that this was simply a *dislocation without a fracture*. *British Med. Jour.*, 1862, i, 140.

3. **Dermarquay** (1866).—Woman of 38. Struck by a carriage on shoulder and fell on elbow. Subcoracoid luxation. Impossible to reduce under chloroform. *Oger, loc. cit.*, No. 40.

4. Fraser (1867).—Boy of 15. Caught by a crank of a balance wheel. Multiple injuries. Among them, a "downward dislocation of the humerus, and, upon rotating it after reduction, crepitation was very perceptible at the joint, showing a fracture at the anatomical neck." Final result: "The shoulder-joint, to all appearances, is as natural as before the accident." *Amer. Jour. Med. Sci.*, 1860, lvii, 372.

5. Gosselin (1869).—Caused by a fall. Head of bone luxated into axilla. Failure to reduce after union. *Oger, loc. cit.*, p. 55.

6. v. Mosengeil (1874).—Railroad employé. Head replaced by manipulation. Good result. *Arch. f. klin. Chir.* xvi, 524.

7. Bouilly (1884).—Man of 48. Fell from a tree. Both bones of forearm also broken. Reduced easily on the 8th day, without chloroform, by continuous extension with apparatus of Hennequin. Home in a month. Final result as to function unknown. *Oger, loc. cit.*, No. 16.

8. Bertini (1885).—Intracoracoid luxation. Easy reduction by pressure. *Poirier et Mauclaire, loc. cit., Obs. 9.*

9. Prewitt (1901).—Man of 27. Fell from a wagon in a runaway. Head easily replaced under chloroform. *Interstate Med. Jour.*, 1901, viii, 61.

III.—Specimens Without Clinical History.

(6 in all)

1. Cooper (1824).—Specimen clearly delineated on a plate. Head had formed a false joint on the scapula. It was united by a little tongue of bone to the body of the humerus. Humerus had formed a false joint at the glenoid cavity. *Guy's Hosp. Rep.*, 1839, iv, 275.

2. Huguier (1852).—"The head of the humerus had been separated from the bone and placed between the subscapular and serratus magnus. It adhered to the bone and was found bare in the hollow of the axilla. As there was no anchylosis, it is probable that the patient had use of her arm." *Oger, loc. cit.*, Obs. 4.

3. Dupuytren's Museum.—Specimen No. 729. Intracoracoid luxation. *Oger, loc. cit.*, p. 27.

4. St. Bartholomew's Hospital Museum.—Specimen No. 103, Subcoracoid dislocation. Fibrocartilaginous union. *Gurlt. loc. cit.*, Obs. 114, p. 704.

5. Museum College of Surgeons of Ireland.—Subglenoid dislocation. *Bennett in Brit. Med. Jour.*, 1881, i, 638.

6. Leo (1903).—Dissecting room specimen. Aged woman. Fracture of both anatomical and surgical neck. Subcoracoid luxation with nearthrosis. Free motion at shoulder on cadaver. *Bull. et Mem. Soc. Anatom. de Par.*, 1903, 6th Ser., v, 248.

MECHANISM OF THE INJURY.

The manner in which this peculiar injury is produced has engaged the attention of surgeons since the report of Houzelot's case by Delpech in 1808.

Delpech (quoted by Poirier and Mauclaire, *l. c.*) believed that the fracture of the anatomical neck occurs first; then enucleation of the head through the capsule by direct force.

Lallemand (1827) was of the opinion that the luxation occurs first; then the fracture *by muscular contraction against the coracoid process or the ribs.*

Sir Astley Cooper (1839) expressed himself thus: "This accident generally occurs in the following way: A person falls and pitches with violence on his shoulder, or a heavily laden carriage passes over it. By the first impression of the accident, the *os humeri* is dislocated; and, by a second, the neck of the bone is broken, and the head detached and lodged in the axilla." (Bennett has called attention to the fact that in none of the recorded cases was the injury produced by the passage of a carriage-wheel over the shoulder.)

Malgaigne (1855) said: "It is very difficult to define exactly the mechanism by which the two lesions, dislocation and fracture, are produced; to determine whether the two lesions are simultaneous; or which precedes the other; whether they are due to direct or indirect injury." However, in his chapter on subluxations of the humerus (in which he was a believer), he called attention to certain specimens of old unreduced dislocations which exhibited a groove or gutter, either on the upper aspect of the head itself or at the upper part of the anatomical neck; and he asked the question "whether sometimes these (grooves) are not produced at the same time as the luxation *by crushing of the head against the glenoid border.*"

Mr. Joseph Bell (Edinburgh Med. Journal, 1863) refers to a case of pertubercular fracture, with dislocation, in which the head and lesser tuberosity were separated from the rest of the bone, and he asks: "How is this fissure produced? Not by any peculiarity in the direct violence which caused the injury, not by any conceivable action of the muscles, but *by the sharp edge of the glenoid border being forced as a wedge against the posterior groove of the humerus.*"

Spence (1863), whose case was doubtful as to the line of fracture, said: "As it is scarcely conceivable that both injuries could have occurred at the same time, it is probable that she dislocated her shoulder by the fall, and subsequently fractured her humerus while rolling down the stair."

Bennett (1880) expressed the following opinion: "Fracture of the upper extremity of the humerus, occurring as a complication of dislocation, commences at that part of the anatomical neck which rests, after dislocation has taken place, against the border of the glenoid cavity. It is caused by *pressure of the humerus against the sharp edge of the glenoid cavity,* probably resulting from a constrained position preventing the separation of the elbow from the side, as in ordinary dislocations."

The suggestion by Malgaigne that the indentations on the head or on the anatomical neck of his specimens of old unreduced dislocations might have been produced by the primary violence forcing together the sharp edge of the glenoid and the head or neck of the humerus, and the unqualified opinion of Mr. Joseph Bell that his pertubercular fracture-dislocation was produced in this way, received an interesting confirmation by some later specimens of recent dislocations.

Mr. Eve (Med. Chir. Trans., 1886, LXIII, 317, quoted by Caird in Edinburgh Med. Jour. 1887, XXXII, Pt. 2, 711) reported the case of a man of 36 years, who was knocked down by a train and sustained a subcoracoid dislocation, in addition to other injuries, from which he died in 12 hours. Reduction was easily effected before death. At the autopsy there was found "a deep vertical indentation or groove at the posterior margin of the articular surface of the head of the humerus, into which the anterior margin of the glenoid cavity accurately fits. It appears to have been produced by the violent impact of the head against the prominent rim on which it probably lodged."

Dr. Francis M. Caird (*loc. cit.,* p. 710) describes two recent specimens without history, which are in the Museum of the University of Edinburgh. Both exhibit almost precisely the same kind of indentation along the anatomical neck as is described by Eve. Dr. Caird's illustration of one of his specimens is reproduced in Fig. 3.

Broca and Hartmann (Bull. de la Soc. Anat., 1890, No. 14, quoted by Stimson), also report a similar specimen in which "the indentation lay wholly or in part along the junction of the head and shaft, above and behind the greater tuberosity, was from one to one and one-half inches long and from one-quarter to one-half an inch deep and accurately fitted the inner lip of the glenoid fossa."

Stimson, in his excellent work on "Fractures and Dislocations" (1905) says, "Fracture of the anatomical neck (with dislocation) is difficult of explanation. The probable cause, in my opinion is the wedge-like action of the inner edge of the glenoid fossa against the anatomical neck."

Salmon (Med. Council, 1900, V, 134) writes as follows: "Fracture of the anatomical neck of the humerus usually occurs in conjunction with dislocation. It may occur after the head of the bone has left the glenoid cavity, the sharp antero-inferior margin of the cavity acting as a wedge. The mechanical production of this fracture is illustrated by a lever of the first class, the power being represented by the weight of the arm and any force applied below the insertion of the deltoid. The fulcrum is the attachment of the deltoid, and the weight is the resistance encountered at the antero-inferior margin of the glenoid cavity."

ANALYSIS OF THE CAUSES OF THE INJURY, IN THE CASES HERE RECORDED, AS BEARING ON THE MECHANISM.

Of the 29 undoubted cases with clinical history, the cause of the injury is stated in 22. *In these 22 cases, without a single exception, the cause of the injury was a fall.*

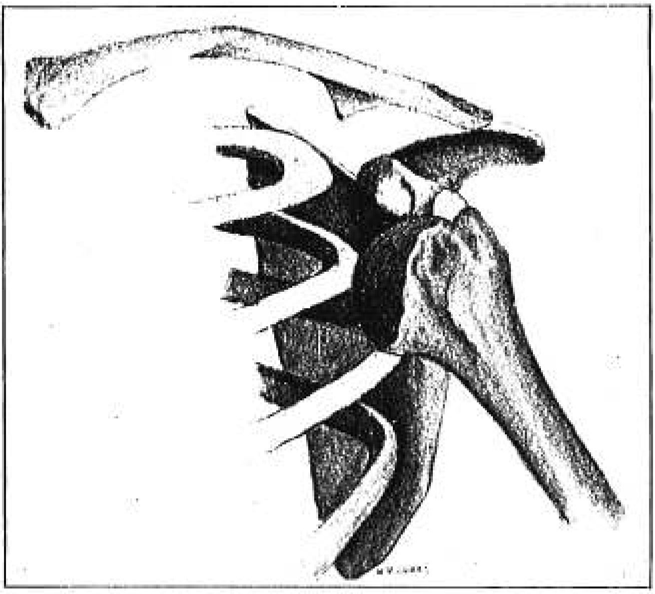
Fall to the ground, by tripping, 6 cases: (Travers, Poirier, Poirier and Mauclaire, Keen, Curtis, Buchanan).

Fall from apoplexy, convulsions or heat strokes, 4 cases: (Houzelot, Lenoir, Curtis, McBurney).

Fall by being struck by carriage, 1 case: (Jepson).

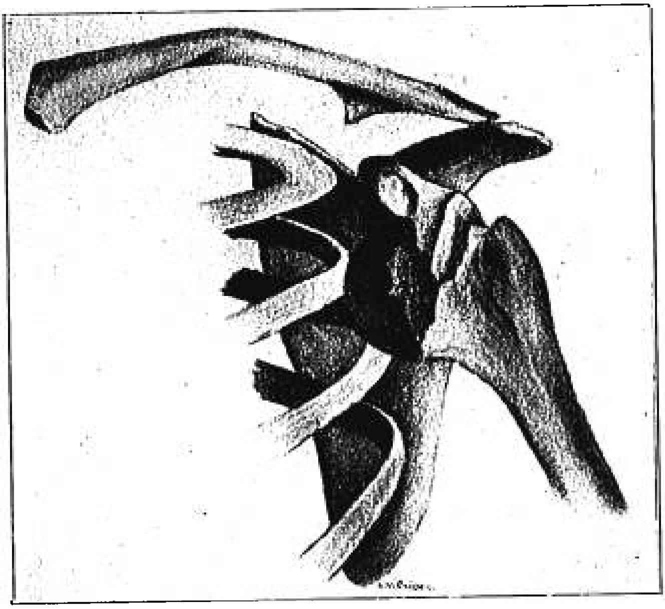
Fall from a horse, 3 cases: (Cooper, St. Thomas' Museum, Mabboux).

FIG. 4.



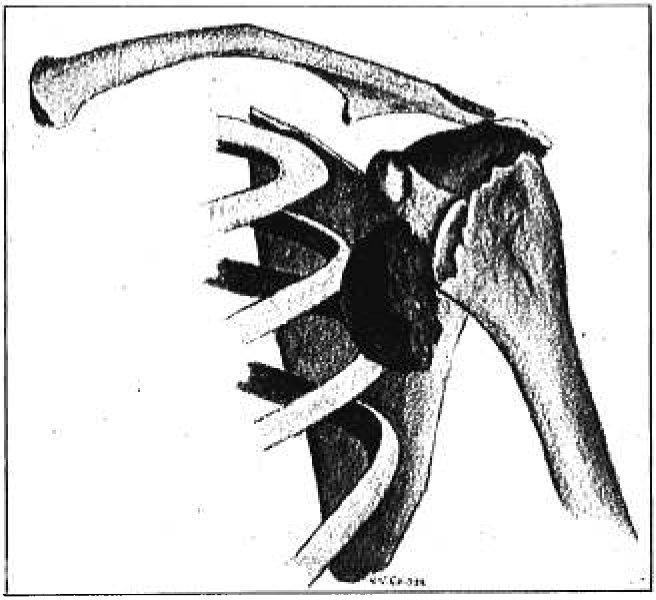
Showing upper part of anatomical neck pressed against anterior margin of the glenoid process.

FIG. 5.



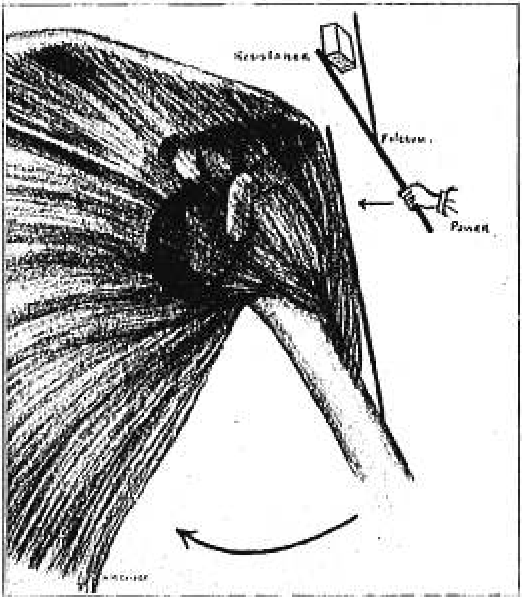
Showing head of humerus being separated by line of fracture through the anatomical neck by wedge-like action of margin of glenoid process.

FIG. 6.



Head complete split off by force illustrated in Figs. 4 and 5.

FIG. 7.



Muscular leverage exercised to separate shaft of humerus from fractured head.

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Fall from a vehicle, 2 cases: (Gerster, Brigham).

Fall down stairs, 3 cases: (Key, Morton, Salmon).

Fall from a height, 3 cases: (Lallemand, Surg. Manch. R. I., Croft).

CONCLUSIONS AS TO THE MECHANISM INVOLVED.

Those specimens of dislocation of the humerus, with indentations of the anatomical neck, described by Eve, Caird (Fig. 3), and Broca and Hartmann show clearly that, in certain cases, after dislocation has occurred in the usual manner, by hyperabduction of the limb, and the head is resting under the coracoid, with the upper part of the anatomical neck against the lower and anterior sharp margin of the glenoid process (Fig. 4), a new application of force occurs, which is transmitted through the shaft of the bone and pushes the anatomical neck with sufficient force against the glenoid edge to make the indentation.

If we now suppose that this force is greater, or the neck, by reason of the atrophy of age, is less resistant, we have a partial separation of the head from the shaft by the wedge-like action of the glenoid as shown in Fig. 5. It is perfectly conceivable that, in many cases, this force should continue to act till the head is completely split from the shaft in the line of the anatomical neck (Fig. 6). On the other hand, it seems more probable that, as the body pitches forward in falling, the arm, which at first is abducted and then pushed upward in the axis of the humerus, should be forced against the body in adduction.

The inevitable result of this adduction of the elbow would be to cause a strong leverage as shown in Fig. 7, in which the long arm is the humerus from the insertion of the deltoid down to the point of application of the force; the short arm is that portion of the bone from the deltoid attachment to the anatomical neck; and the fulcrum is the insertion of the deltoid muscle.

It is therefore probable that a fall on the outstretched arm or hand may cause (1) a dislocation; that, if the body pitches forward with the hand or arm still on the ground, the force is applied in a new direction—along the line of the shaft—and (2) an indentation of the neck occurs or (3) a partial or complete separation of the head; that, if the body is projected further forward, the force is applied in still another direction—compressing the elbow to the side—and (4) the partial cleavage of the neck is completed by a strong leverage of the arm.

In a very large proportion of the cases, repeated efforts at reduction were made before the double injury was discovered and these will account for the different locations of the head and the different degrees of its impaction in the soft tissues.

TREATMENT.

1. *Restoration of the dislocated head to the glenoid cavity by external manipulation.*

There is no recorded case of anatomical neck fracture-dislocation, in which reduction has been accomplished by external means and the line of fracture verified by the X-ray or by autopsy. At the same time, the unverified cases of Fraser, v. Mosengeil, Bouilly, Bertini, and Prewitt, in which the replacement was accomplished, certainly make it incumbent on the surgeon to make an effort at reduction if the head of the bone can be shifted without undue violence.

2. *Restoration of the dislocated head by open incision.*

This has been done in but three cases of true anatomical neck fractures, with one good result, one fair result, and one result which could be counted fair at the end of seven weeks, the time of report. The operation is difficult, and requires much manipulation. In one case, both anterior and posterior incisions were made, and a temporary resection of the acromion. In two cases, the fragments required fixation with drill and peg. The risks of such a severe traumatism, the creation of a compound fracture in immediate proximity to a large opened joint, and the frequent necessity of fixing the fragments by peg or drill would hardly seem to be compensated by the results so far obtained. In a case, however, where reduction could be accomplished without much manipulation and the fragments approximated satisfactorily, it is probable that no surgeon would hesitate to try to restore the integrity of the joint.

As an aid to the replacement of the fragment, use may be made of the bodkin invented by Simon Duplay to *push* the head into place. It is described by Poirier and Mauclaire (1892) as a steel rod, 6 to 8 centimetres long and 3 to 4 millimetres in diameter, held by a thick, short handle, and terminated by an abruptly conical point. Or the well-known hook of McBurney (1894) may be used to *pull* the head into place.

3. *Excision of the dislocated head.*

This seems to be the operation of choice, having been performed in 14 cases, with 2 results called excellent; 6, good; 1, moderately good; and 2 deaths to its discredit.

One of these deaths (Morton's), in the first case operated on, seemed to have no connection with the operation or injury. On the face of the reports as to functional results, excision of the head would seem to be preferable to replacement. The number of cases, however, is yet too small on which to base a decided opinion.